THE INFLUENCE OF PHYSICAL AND CHEMICAL PROPERTIES OF PORK FAT ON THE QUALITY OF HEAT TREATED MEAT PRODUCTS

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Background

The influence of the fatty acid profile on the quality of fresh meat is well described (Eggert *et al.* 2001;Fiedler *et al.* 2003;Nguyen *et al.* 2003). However, knowledge about the influence of physical and chemical properties of fat in heat treated meat products is insufficient. Fat undergo solid-to-liquid phase transitions between ambient and body temperature. This reversible phase transition is highly desirable when fat is used as a functional ingredient in food providing properties such as structure, mouth feel, flavour delivery, and barriers to moisture migration. Vegetable and animal fat are polymorph, meaning they have several solid phases. Each solid phase has a certain melting point and consistency. This phenomenon has in detail been studied in cocoa butter where control of the crystallization process is essential for the eating quality of the chocolate (Schlichter-Aronhime and Garti 1988). All triglycerides have individually polymorphic properties depending on their fatty acid distribution and composition (Sato 2001). The triglycerid composition is different depending on the origin of the pork fat; leaf fat contains more saturated fatty acids than lard fat. Pork fat crystallization properties during production of heat treated meat products have only sparsely been studied and never systematically correlated to processing parameters and the sensory quality of the final meat products. This paper reports results from a fundamental study of lard/leaf fat crystallization and melting using Differential Scanning Calorimetry (DSC).

Objectives

The objectives of this study were to describe the physical properties of pork lard and leaf fat in pure form and as an ingredient in liver pâté.

Materials and methods

Two sources of pork fat were used in this study – lard and leaf fat. The physical and chemical properties of the fat were investigated in 3 different products: Pure fat extracted using chloroform by the method described by Folch *et al.* (1957) with minor modifications and raw unextracted fat as an ingredient in liver pâté. The ingredients in the liver pâté are listed in Table 1. The melting points for each product were determined with a DSC 820, Mettler Toledo (Schwerzenbach, Switzerland) based on the heat flux principle and cooled with liquid nitrogen. Experimental conditions were identical for all products: The samples were held at 80 °C for 30 minutes, cooled to (-20) °C with different cooling rates (0.5 °C/min, 1.0 °C/min, 5.0 °C/min, and 10 °C/min), and subsequently heated to 80 °C (heating rate: 1.0 °C/min and 5.0 °C/min).

Table 1 Liver pâté, list of ingredients.

Ingredients	Quantity	Ingredients	Quantity
Pork fat	37.04 %	Salt	0.93 %
Lard	30.35 %	Dried onions	0.56 %
Soup[1]	25.20 %	Glucose	0.19 %
Wheat fluor	3.09 %	White pepper	0.15 %
Dried milk	2.47 %	Thyme	0.03 %

[1] Soup is the designation of lard boiled in water.

Results and discussion

The melting curves of extracted lard and extracted leaf fat are not identical (Figure 1). This is probably due to differences in the fatty acid profile of the two fat sources. Leaf fat has the highest melting point at 48 °C while lard has the highest melting point at 39 °C, indicating that leaf fat is more saturated than lard fat. The number of melting points is almost similar for the two kinds of fat – 5 or 6 melting points were recorded depending on the cooling rate. In a study of particle size of lard fat, it was also found that lard fat have 6 crystal fractions at a cooling rate of 0.5 ºC/min (Wang and Lin 1995). From Figure 1 it can be seen that different cooling rates leads to different appearances of the curves. Consequently the cooling rate has an effect on fat crystallization in pork fat. The cooling rate was found to have an effect on both the lard and leaf fat. The peaks are more separated for slowly cooled fat than for fast cooled. This effect may be due to the fact that triglycerides have more time to embed in more stable crystal forms during slow cooling.

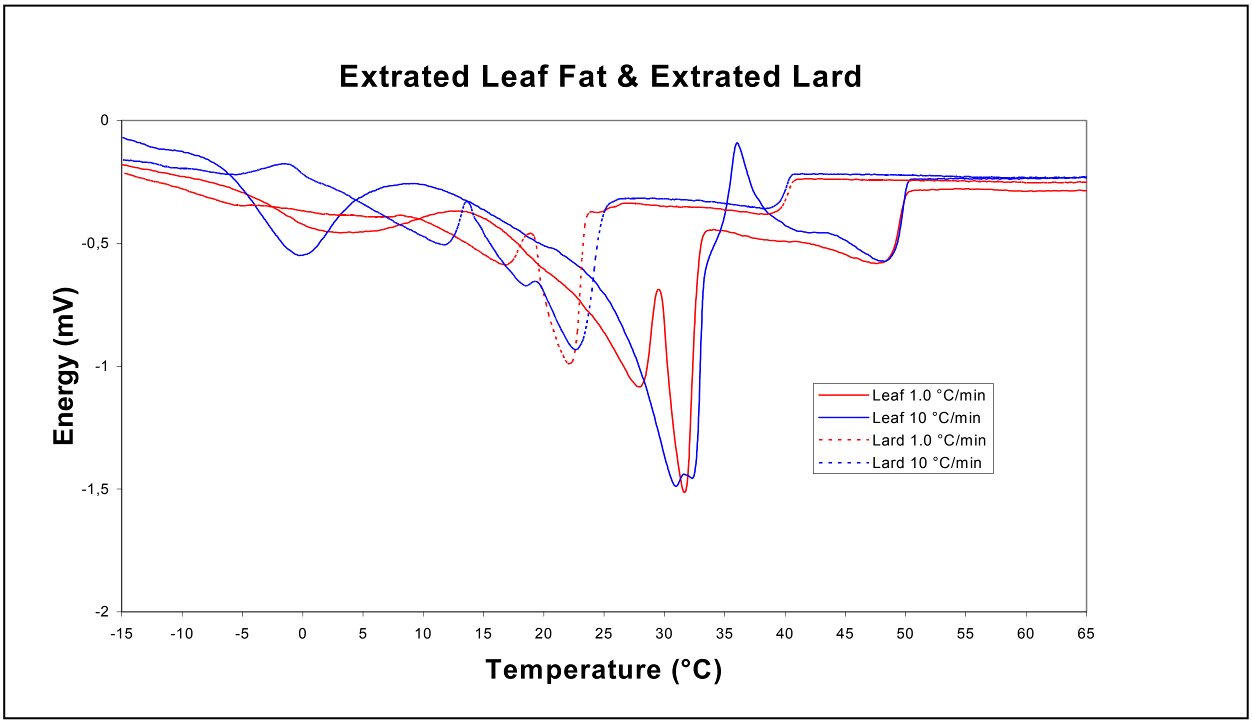

Figure 1 DSC melting curves of extracted lard and leaf fat. Heating rate: 1.0 °C/min. Inserted box indicates cooling rates.

The thermogram of the liver pâté in Figure 2 has the largest peak around 0 °C, due to water melting. The size of the peak indicates that liver pâté contains a significant amount of water. Due to the size of the water melting peak, central information about fat melting peaks might be hidden. Figure 2B is an enlarged version of the marked area in Figure 2A. From Figure 2B it is possible to see that the melting curves have several peaks. The slowest cooled sample has five exothermic peaks and the fastest cooled sample has four exothermic peaks indicating melting of fat crystals. This means that the cooling rate also has an effect on the melting properties of the liver pâté. It may thus be possible to produce liver pâtés with different lipid crystals, leading to varying consistence of the liver pâtés depending at the cooling rate. Future experiments will show if it is possible, by means of sensory experiments, to distinguish any differences in the mouth feel of differently cooled liver pâté.

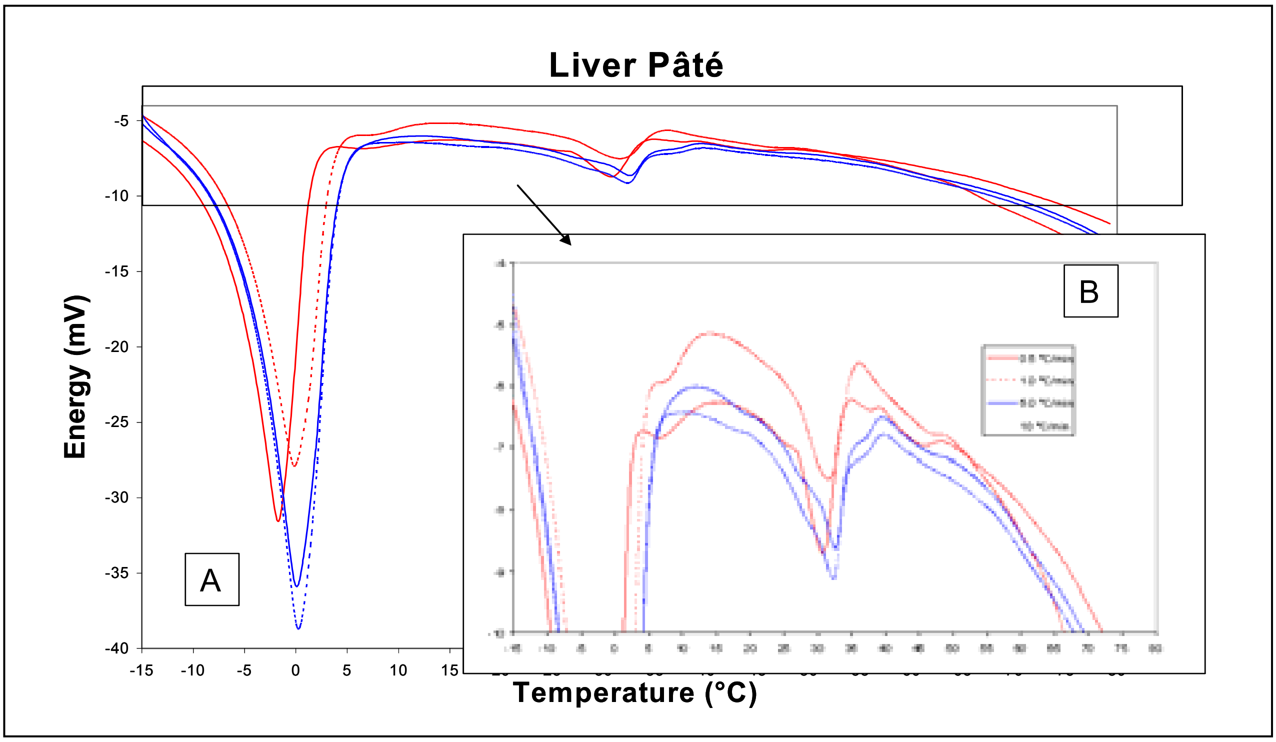

Figure 2 DSC melting curves of Liver pâté made of lard fat - heating rate 1.0 °C/min. B is an enlarged version of the marked area in A.

Conclusions

The cooling rate has a significant effect on the crystallization of both lard and leaf fat. The two sources of fat have 5-6 melting points depending on the cooling rate. The fat crystallization in liver pâté is also effected by the cooling rate. Consequently the cooling rate can most probably chance the physical properties of the liver pâté – i.e. it is possible to change the texture of the liver pâté by controlling the cooling rate after the liver pâté has been baked.

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